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EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER
ON LAND AND ON GLACIERS

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Type I Progress Report for Period 1 September - 31 October 1973

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Prepared for:

Goddard Space Flight Center
Greenbelt, Maryland 20771

Type I Progress Report
ERTS-1

a. Title: Evaluate ERTS imagery for mapping and detection of changes of snowcover on land and on glaciers.

ERTS-A Proposal No.: 342-7

b. GSFC ID No. of P.I.: IN 045

c. Statement and explanation of any problems that are impeding the progress of the investigation:

No official word has been received on the status of our Data Analysis Plan dated 1 May 1973, which requested additional funds to study 1973 summer images; nor has any preliminary information been forthcoming on the status of these funds. Thus work has only proceeded at a low level of effort, in order to save enough money to prepare the final reports.

Missing data continue to be a serious problem. For instance, in the most intensively studied area (Test Site 1), data have been received from only about 50% of the ERTS overpasses during the 1973 melt season. Some of these missing data can be explained by cloud cover greater than stipulated, but we are also missing crucial data at times of minimal clouds. Thus the critical time-sequence analyses cannot be made. Difficulties have also occurred in scheduling high-altitude aerial photography to coincide with clear weather ERTS overpasses. This was not accomplished until October 3, 1973, which was past the end of the melt season. Finally, delay in transmission of data makes it impossible to produce timely releases and reports (one may receive imagery one month after an ERTS pass, if not one waits another month to make sure it is not coming routinely, then files a Data Request and waits 1-3 months for it to come through, a total delay of 3-5 months).

d. Discussion of the accomplishments during the reporting period and those planned for the next reporting period:

Images sent for ESIAC analysis, mentioned in the last Type I report, have not yet been processed at SRI.

ERTS imagery of the Olympic Peninsula, Washington, has been examined as a substitute for the poor time series of North Cascades imagery. The snowline altitude in the upper Hoh River basin has been determined using topographic maps at 11 times from 30 July 1972 to 11 August 1973. These results will be compared with equivalent snowline altitude (ESA) data derived by the SRI ESIAC when it becomes available.

Operator variance measurements were made for a number of analysis techniques. High-altitude aircraft and ERTS imagery were also used to estimate the uncertainty of detection of snowcover in forested areas. These results were then compiled to yield estimates of standard error of measurement of snowcovered area as a function of time of the year for the North and Middle Cascades, Washington.

ERTS images were searched for evidences of dangerous glacier dammed lakes, new surges, and major changes in tidal glacier termini. Unfortunately, the two most important new surges in Western North America (Russell and Tweedsmuir Glaciers) were detected by aerial photography before the appropriate ERTS images were received from NASA. Excellent images have now been received and will be compared with images from late summer 1972 to see what changes could be detected. The surging Lowell Glacier was mapped, and an ERTS image acquired over the Pamir Mountains was also studied. A 20 September 1973 image of Columbia Glacier, Alaska, received just before this report was written, shows an almost catastrophic change in the calving terminus and will be carefully compared with earlier images.

e. Discussion of significant scientific results and their relationship to practical applications or operational problems including estimates of the cost benefits of any significant results.

The standard error of measurement of snowcovered area in major drainage basins in the Cascade Range, Washington, using single measurements of ERTS images, was found to range from 11 percent (1 April) to 7 percent (30 September) during a typical melt season, but was as high as 32 percent in midwinter. A typical basin snowcover diminishes at about 1.5 percent per day during the melt season; thus these techniques cannot provide useful data at time intervals less than 14-22 days. Although this is approximately the return interval of ERTS, more frequent ERTS passes would be required to take advantage of this powerful tool because of the cloud cover difficulty.

Many dangerous glacier situations in Alaska, Yukon, and British Columbia were observed on ERTS imagery. Glacier dammed lakes in Alaska which are being monitored by ERTS include Skilak, Blockade, Strandline, George, Tazlina-Nelchina Glacier lakes, Columbia Glacier Lake, Van Cleve, Berg, and Canyon.

Embayments in tidal glaciers show changes detectable by ERTS. The Hubbard Glacier (previously discussed) shows continuing change. The Columbia Glacier shows a huge embayment now forming which may presage a disastrous retreat accompanied by a huge stream of icebergs into the navigable waters of Prince William Sound.

Surges of Russell and Tweedsmuir Glaciers, now in progress, are clearly visible in ERTS imagery. The Tweedsmuir surge is likely to dam the large Alsek River by mid-November, producing major floods down-river next summer. Russell Glacier is advancing into Upper Skolai Lake.

An ERTS image on 12 July 1973 of the Pamir Mountains, Tadjik S.S.R., has been obtained. It shows the surging Medvezhii (Bear) Glacier just after its surge of early summer which dammed the Abdukagor Valley creating a huge lake and later a flood in the populous Vanch River valley. Study of this image shows six other undoubted surge-type glaciers (one of which appears ready to surge) and at least 16 suspected surge-type glaciers.

Finally, a map was compiled from an ERTS image of the Lowell Glacier after its recent surge, compared with an earlier map painstakingly compiled from a mosaic of many aerial photographs, both maps reduced to a common map scale, and measurements made of the direction and amount of surge displacements at three points along the length of the glacier--in a total elapsed time of 1.5 hours. Thus is shown the value of ERTS for rapid mapping of large features.

f. A listing of published articles, and/or papers, preprints, in-house reports, abstracts of talks, that were released during the reporting period:

Presentation "ERTS applications to snow and ice" at meeting of Committee on Polar Research, National Academy of Sciences, Boulder, Colorado, 26 October 1973.

g. Recommendation concerning practical changes in operations, additional investigative effort, correlation of effort and/or results as related to a maximum utilization of the ERTS system:

None.

h. A listing by date of any changes in Standing Order Forms:

7 November 1972

1 May 1973

i. ERTS Image Descriptor forms:

In preparation.

j. Listing by date of any changed Data Request forms submitted to Goddard Space Flight Center/NDPF during the reporting period:

29 October 1973.

k. Status of Data Collection Platforms:

N/A